Contents

Editor's note v

Keynotes

Cross shear roll bonding
N. Bay, H. Bjerregaard, S.B. Petersen (Lyngby, Denmark) and C.H.G. dos Santos (Sao Paulo, Brasil) 1

Friction models for finite element modelling
D.M. Petty (Grangetown, Middlesbrough UB) 7

Development of OSU formability test and OSU friction test
R.H. Wagoner, W. Wang and S. Sriram (Columbus, OH) 13

Inertia effects in finite-element simulation of metal forming processes
M.P. Miles, L. Fourment and J.L. Chenot (Sophia-Antipolis, France) 19

Forging

Precision forging straight and helical spur gears
M.H. Sadeghi (Tehran, Iran) and T.A. Dean (UK) 25

Improved coining press dynamics-balancing the forces
M.D. Faulkner (Bedford, UK) 31

Special preparation of the ingots for deformation on the automated forging centre
S.P. Burkin, V.L. Kolmogorov, N.A. Babailov and E.H. Shakhpazov (Russia) . . . 37

Fast simulation system for axisymetrical stamped-parts deformation
Ph. Marin, J.F. Boujut and S. Tichkiewitch (Grenoble Cedex, France) 43

The results and perspectives of the particles method approach in investigations of plastic deformations
W. Dzwinel, W. Alda, J. Kitowski and J. Mościński (Cracow, Poland) 51

Indirect analysis of boundary stresses
E. Doege and Ch. Bederna (Hannover, Germany) 57

Modelling drawbeads with finite elements and verification
B.D. Carleer, P.T. Vreede, P. Drent, M.F.M. Louwes and J. Huétink (The Netherlands) 63

Implicit and dynamic explicit solutions of blade forging using the finite element method
B. Soltani, K. Mattiasson and A. Samuelsson (Göteborg, Sweden) 69

Three dimensional forging simulation with finite element control
J. Terziyski, T. Aizawa and J. Kihara (Tokyo, Japan) 75

Industrial applications of numerical simulation to the design and optimization of forging processes
F. Espiga, A. Jugo and J.J. Anza (Bilbao, Spain) 81

Production of tubular components by radial extrusion – a finite element analysis
S.B. Petersen, J.M.C. Rodrigues and P.A.F. Martins (Lisboa, Portugal) 87

A consultative system for cold forging with finite element predictions
B. Lengyel, I.A. Chaudhry and R.D. Hibberd (London, UK) 93

Rolling

The effect of aspect ratio upon friction and normal forces in strip rolling
J. Jeswiet and X. Cao (Ontario, Canada) 99

Elsevier Science B.V.

Determination of the contact area between the rolling tools and the workpiece in cross rolling process
Zb. Pater and W. Weroński (Lublin, Poland) 105
Residual stress distribution in cold rolled brass sheet
T. Wu, C.S. Hartley, X.M. Wang and C.T. Tsai (USA) 111
Roll bite conditions controlling formation of wear debris during cold rolling of aluminium
K.R. Januszkiewicz, G. Stratford and T. Ward (Ontario) 117
An investigation into the control of thermal camber by spray cooling when hot rolling aluminium
P.A. Atack and I.S. Robinson (England) 125
Experimental study of cooling characteristics in hot rolling
J. Horský, M. Raudenský (Czech Republic) and W. Sauer (Germany) 131
Control of strain and temperature distribution in the ring rolling process
A. Kluge, Y.-H. Lee, H. Wiegels and R. Kopp (Aachen, Germany) 137
Three-dimensional finite-element modelling of ring rolling
Z.M. Hu, I. Pillinger, P. Hartley, S. McKenzie and P.J. Spence (UK) 143
Numerical analysis of asymmetric rolling accounting for differences in friction
A. B. Richelsen (Lyngby, Denmark) 149
The application of computational and experimental techniques to metal deformation in cold roll forming
R.S. Senanayake, S. Thiruvarudchelvan (Singapore) and I.M. Cole (UK) 155
Determination of forming path in three-roll bending using FEM simulation and fuzzy reasoning
G. Yang, K. Mori and K. Osakada (Osaka, Japan) 161
Theoretical and experimental analysis of plates asymmetric rolling
H. Dyja, P. Korczak, J.W. Pilarczyk and J. Grzybowski (Czestochowa, Poland) . . 167
The behaviour of thin-walled, aluminium alloy profiles in rotary draw bending – a comparison between numerical and experimental results
T. Welo, F. Paulsen and T.J. Brobak (Norway) 173
Continuous four-roll plate bending process: its bending mechanism and influential parameters
M. Hua, K.P. Rao (Hong Kong) D.H. Sansome (England) and
K. Baines (Australia) 181
Thermomechanical simulation of seamless tube rolling using a 3D finite element method
G. Sola, M. Vacance, E. Massoni and J.-L. Chenot (Sophia Antipolis Cedex) . . . 187
The development of an automated forming machine for the manufacture of airbus stringers
J.P. Scanlan (England) and J.D. G. Laughton (Chadderton) 193
Experimental validation of a rolling stand elastic deformation model
A. Hacquin, P. Montmitonnet, J.-P. Guillerault (France) 199
Mill roll texturing using EDT
J. Simão, D.K. Aspinwall, M.L.H. Wise and M.F. El-Menshawy (Birmingham, UK) 207
The influence of different work-roll texturing systems on the development of surface structure in the temper rolling process of steel sheet used in the automative industry
O. Pawelski, W. Rasp, W. Zwick, H.-J. Nettelbeck and K. Steinhoff (Germany) . . . 215

Sheet forming

Numerical simulations of wall wrinkling in food can drawing
J. Proubet (Voreppe, France) 223

Prediction of the localized necking in 3D sheet metal forming processes from FE simulations
N. Boudeau and J.C. Gelin (France) 229

Numerical simulation of multi-operation sheet forming processes
H.-L. Cao (Metz, France) 237

The incremental flow formulation for the finite element analysis of 3-dimensional superplastic forming processes
J. Bonet, P. Bhargava and R.D. Wood (Swansea, UK) 243

Methods for resolving grooving problems in parts manufactured from combined diffusion bonding and superplastic forming processes
J.-H. Cheng and S. Lee (Taiwan) 249

Finite element analysis of roll-forming of thin sheet metal
M. Brunet and S. Ronel (Villeurbanne, France) 255

Quasi-static analysis of sheet metal forming processes – a design evaluation tool
S.C. Tang (MI, USA) 261

Investigation into tool surface description for finite element analysis of three-dimensional sheet metal forming processes
D.Y. Yang, D.J. Yoo, I.S. Song and J.H. Lee (Korea) 267

Extrusion and drawing

Pressure welding of corrosion resistant metals by cold extrusion
H.W. Wagener and J. Haats (Kassel, Germany) 275

Residual stresses in codeformed composite cylinders
R. Bullough and C.S. Hartley (FL, USA) 281

Residual stresses in cold extrusion and cold drawing: a finite element and neutron diffraction study
N.T. Rudkins, G.F. Modlen and P.J. Webster (England) 287

Analysis of inhomogeneity of mechanical properties in stainless steel rods after drawing
L. Sadok, J. Łuksza, J. Majta and A. Skołyszewski (Kraków, Poland) 293

The influence of controlled twisting on drawing of OFHC copper and Armco bars
M. Cywinski and R. Wusatowski (Gliwice, Poland) 299

Analysis of the strain state in the stainless steel rods after drawing
L. Sadok, J. Łuksza, M. Paćko and M. Burdek (Poland) 305

An Eulerian elastoplastic FEM solution to drawing processes
Z. Malinowksi (Kraków, Poland) 311

Deep drawing

The simulation of multi-operation deep-drawing process at Renault with PAM stamp™
M. El Mouatassim, J.P. Jameux, B. Thomas, F. Mehrez and G. Milcent (France) . 317

Industrial integrated methodology for deep-drawing processes optimization by numerical simulation
M. Guida, X. Li, A. Messina and P.P. Strona (Centro Ricerche Fiat) 323

Experimental and numerical modelling of the effects of process parameters in the aquadraw deep drawing
J.C. Gelin, P. Delassus and J.F. Fontaine (France) 329

Tube forming

Assessment of the strain distribution in the rotary piercing process by the finite element method
S. Urbanski and J. Kazanecki (Kraków, Poland) 335

Pass geometry and macroshear redundancy effects in a 3-roll conical oblique tube piercing process
W.A. Khudheyer, D.C. Barton and T.Z. Blazynski (Leeds, UK) 341

Theoretical and experimental investigation of the multilayer tube drawing
W. Szulc and Z. Malinowski (Poland) 347

Unconventional process

Magnetic powder forming simulation subjected to pressing in magnetic field
S. Tamura, T. Aizawa and J. Kihara (Tokyo, Japan) 353

Semi solid forming of aluminium alloys by direct forging and lateral extrusion
G. Hirt, R. Cremer, A. Winkelmann, T. Witulski and M. Zillgen (Simmerath, Germany) 359

Some aspects of plastic deformation of metal alloys in partly liquid state
W. Lapkowski and M. Pietrzyk (Kraków, Poland) 365

Size effect in the Fe-simulation of micro-forming processes
A. Messner, U. Engel, R. Kals and F. Vollertsen (Erlangen, Germany) 371

Liquid-bulge-forming as a flexible production method
F. Dohmann and C. Hartl (Paderborn, Germany) 377

Analysis of unconventional TEE forming on metal tubes
L.A.M. Filho, J.C. Menezes and H.A. Al-Qureshi (Brazil) 383

Air bending as a numerically controlled forming process to produce S-shaped bars
M. Reigl, H. Lippmann and V. Mannl (Munich, Germany) 389

Clad materials

Manufacturing processing and properties of clad metals by plastic working
S. Ikeda, S. Saito and K. Suzuki (Japan) 395

Theoretical and experimental analysis of drawing of steel rods covered with copper
W. Szulc, M. Pietrzyk, H. Dyja and J.W. Pilarczyk (Poland) 401

Fabrication of trimetallic strips by explosive cladding and rolling
A.G. Mamalis, N.M. Vaxevanidis (Greece) and A. Szalay (Budapest, Hungary) . . . 407

Metal matrix composites

Near net shape forming of particulate reinforced Al-alloys by isothermal forming compared to semi solid forming
T. Witulski, J.M.M. Heußen, A. Winkelmann, G. Hirt and R. Kopp (Germany) . . 415

Forging of 'H' sections from aluminium metal matrix composite bars, modelled using the finite element method
S.M. Roberts, P.J. Withers, S. Barnes and P.B. Prangnell (UK) 421

Analytical study for the stress analysis of metal matrix composites
D. Huda, M.A. El Baradie and M.S.J. Hashmi (Dublin, Ireland) 429

Material behaviour and characterisation

An inverse method for determining viscoplastic properties of aluminium alloys
J.C. Gelin and O. Ghouati (France) 435

A new model of shear fracture and its applications
E.S. Dzidowski (Wroclaw, Poland) 441

Use of lead to develop models for the deformation behaviour of steel at elevated temperature
C. Roucoules, I. Boyadjev, P.D. Hodgson and B.A. Parker (Victoria, Australia) . . 447
Orthotropic plasticity in metal sheets: a theoretical framework
Z. Tourki, R. Makkouk, A. Zeghloul and G. Ferron (Metz Cedex, France) 453
Workhardening and substructural geometry of metals
P. van Liempt (The Netherlands) 459

Texture and microstructure
Texture development of 50% Ni–Fe strip by powder rolling
T.H. Yim and Y.B. Park (Korea) 465
Effect on hot rolling condition of the development of textures in ultra low carbon steel
Y.B. Park, D.N. Lee (Korea) and G. Gottstein (Aachen, Germany) 471
Simulation of material flow and microstructural evolution during the hot rolling of flat products
R. Kawalla, U. Lotter, H. Pircher (Duisburg) and M. Twickler (Herzogenrath) . . 477
Computer modelling as a tool for visualizing microstructure evolution during the rolling process
R. Colás (Mexico) and J.H. Beynon (England) 485
Metal forming of titanium: experimental, microstructure and computer simulation
J.D. Picksley, F.R. Hall and I. Pillinger (Birmingham, UK) 491
Modelling the evolution of microstructure during hot torsion of niobium microalloyed steels
X.D. Liu, J.K. Solberg, R. Gjengedal and A.O. Kluken (Trondheim, Norway) . . . 497
Plasticity of dual-phase steels and clad steels in a tensile state of stress
J. Elfmark, L. Jelen (Ostrova) and P. Staněk (Brno, Czech Republic) 503
Multistage compression of microalloyed steels – Fe simulation and measurements of grain size
M. Pietrzyk, Z. Kędzierski, J. Matja, (Poland) J.G. Lenard (Canada), and
M. Tajima (Japan) 509

Damage and defects
Influence of steel matrix porosity on the final dimensions and properties of cold stamped bars
B. Bennani and J. Oudin (Valenciennes Cedex, France) 515
On the stable damage model for metal forming processes
K. Benkrid, P. Bussy and A. Abdali (Saint-Quentin Cedex, France) 521
Simulation of defects in metal forming – an example
M. Arentoft, P. Henningsen, N. Bay and T. Wanheim (Lyngby, Denmark) 527
Finite element prediction of microvoid growth during multi-step hot forging
B. Bennani, J. Oudin and D. Lochegnies (Valenciennes Cedex, France) 533
Defect prediction during conform process by FEM
Y. Peng, X. Ruan and T. Zuo (China) 539

Formability
Role of process variables in the modification of forming limit stress curve
W.M. Sing, K.P. Rao and M. Hua (Hong Kong) 545

Prediction of the forming limit diagrams in pulsatory straining
D. Banabic (Romania) and I.R. Dörr (Leinfelden, Germany) 551
Improvement in drawability of high carbon wire rod
K. Nordell, L. Pohjala and M. Rastas (Finland) 557
Workability in upset forging of less-ductile materials
M. Abdel-Rahman (Minia, Egypt) 563
Forming limits in a clad steel
D.W.A. Rees and R.K. Power (Middlesex, UK) 571
The effect of tooling temperature on the formability of sheet steel
D.E. Leighton and D. Lee (NY, USA) 577
A new criterion to predict necking failure under biaxial stretching
Sujit Kumar, P.P. Date and K. Narasimhan (Bombay, India) 583
Criterion of plastic instability and its application for predicting ductility in metal forming Hitoshi Moritoki and Eiki Okuyama (Akita, Japan) 589
Hyperplasticity: enhanced formability at high rates
V.S. Balanethiram, X. Hu, M. Altynova and G.S. Daehn (OH, USA) 595

Friction and surface phenomena
Boundary friction model in punch friction test
T.-C. Hsu and S.-G. Kuo (Taiwan, ROC) 601
Finite element analysis of peening process with plastically deforming shot
K. Mori, K. Osakada and N. Matsuoka (Osaka, Japan) 607
Ultrasonic investigation of friction mechanism in metal forming
S. Stancu-Niederkorn, U. Engel and M. Geiger (Erlangen, Germany) 613
Evaluation of friction in cold metal forming
A. Forcellese, F. Gabrielli, A. Barcellona and F. Micari (Italy) 619
The study of friction in ironing process by physical and numerical modelling
P. Deneuville and R. Lecot (Voreppe, France) 625

Thermal effects
Thermomechanical modelling of aluminium alloy rolling
N. Le Mat, J.H. Beynon and A.R.S. Ponter, (Leicester) and H.L. Yiu (Banbury) . . 631
Evaluation of temperature and heat transfer conditions at the metal forming interface
W. Nshama, J. Jeswiet and P.H. Oosthuizen (Kingston, Canada) 637
Calculation of tool temperature during periodic non steady-state metal forging
M.P. Miles, L. Fourment and J.-L. Chenot (Sophia-Antipolis, France) 643

Numerical modelling techniques
Applications of implicit and explicit finite element techniques to metal forming
A.M. Prior (Cheshire, UK) 649
Large strain dynamic analysis using solid and contact finite elements based on a mixed formulation; application to metal forming
S. Cescotto and Y.Y. Zhu (Belgium) 657
Applicaton of the automatic remeshing to the moving geometries in forging processes
B. Głut, J. Kusiak, J. Sińczak (Poland), T. Coupez and J.-L. Chenot (Sophia-Antipolis, France) 665
Semi-automatic rezone-algorithm for the simulation of 2D-axisymmetric extrusion processes with FEM
A. Behrens, H. Schafstall and D. Landgrebe (Hamburg) 671

Efficient program for finite element calculations of plastic deformations in metal forming processes
M. Bubak, R. Chrobak, J. Mościński and M. Pietrzyk (Poland) 677
Test of an element suitable for fully automatic remeshing in 3D elastoplastic simulation of cold forging
C. Gay, P. Montmitonnet, T. Coupez and J.-L. Chenot (Sophia-Antipolis Cedex, France) 683

Artificial intelligence and computer-aided design
Development of an intelligent knowledge-based system (IKBS) for forging die design
M. Bakhshi-Jooybari, I. Pillinger and T.A. Dean (Birmingham, UK) 689
Interpoaltion of forging preform shapes using neural networks
R. Roy, R. Balendra (Glasgow) and K. Chodnikiewicz (Warsaw) 695
Intelligent design environment: a knowledge based simulations approach for sheet metal forming
R. Palani, K. Narasimhan (Bombay, India) and R.H. Wagoner (OH, USA) 703
Application of physical modeling, FEM and knowledge-based process planning program to forging process design
J.S. Lee, S.S. Hong, S.H. Lee, N.C. Cho and N.H. Kim (Taejon, Korea) 709
Computer aided forging design
J.J. Anza, J.I. Barbero, C. Muga, J. Calvo, A.R. Carrillo and A.R. de Pedro (Bilbao, Spain) 715

Author index Volume 45 721